

# Software Product Maturity in Source Selection

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# Defining SW Product Maturity

- US/UK/AUS Software-intensive Systems Acquisition Working Group work strand
- No standard definitions/scales
- Not Software Technology Readiness Levels (TRL)
  - Maturity addresses a specific product
  - TRL addresses underlying technology
- Highly dependent on environment and application context
- Many dimensions of maturity

# The Approach

- Gathered a group of experts to:
  - Review existing approaches
  - Develop characteristics and information sources
  - Develop guidance for source selection
  - Develop RFQ/RFP language



# Focused on Source Selection

- General maturity problem is extremely difficult
  - Limited time and resources
  - Need for significant effort to work on development-based maturity
  - Some promising work (MDA, AF) but untried
- Source selection has been a Congressional emphasis
- Source selection bounds the problem to measuring existing, working software (e.g. COTS, GOTS, legacy)

# Software in Source Selection

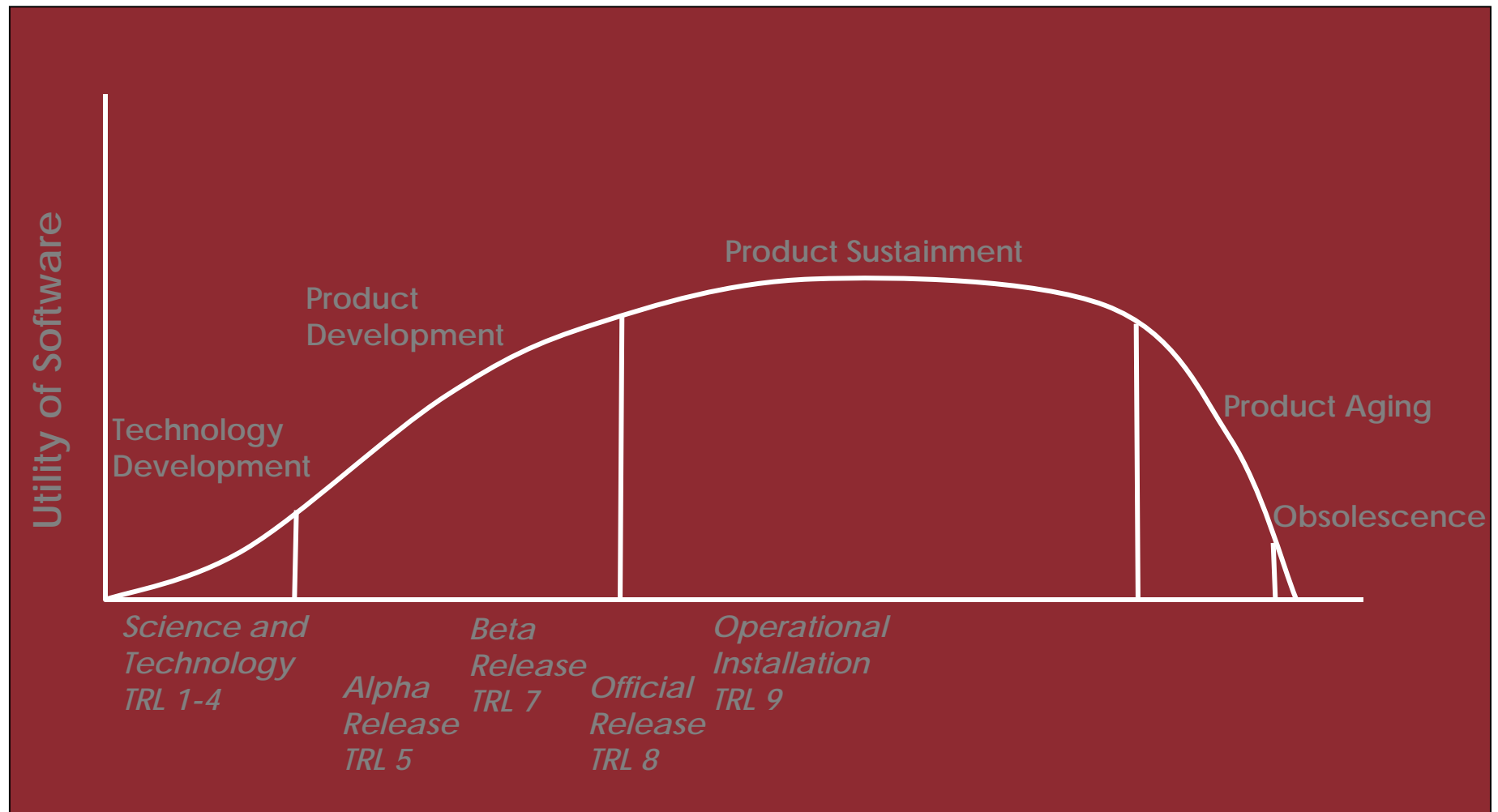
- Many different kinds of source selections
  - Greenfield vs. Upgrade
  - Traditional business-process IT system implementation vs. Command and Control or embedded software
- Different kinds of software in programs
  - Only software that exists has determinable maturity
  - Aggregations of existent and non-existent software are common
- Software doesn't exist (Not measurable)
  - Developmental software
- Software exists (Measurable)
  - COTS
  - GOTS
  - Prototype
  - NDI/Legacy
  - Experimental

# Observations



- **Software product maturity is value-neutral**
  - Mature software not better than immature software in some instances; must be interpreted in light of risk
    - *Web-pages*
    - *Proofs of concept*
- **Software can become senile**
  - Number of changes overwhelm the architecture
  - Environment changes
  - Utility degrades
- **Level of understanding of context directly impacts risk and interpretation of maturity**
  - Poorly understood application environment or target makes risk assessment difficult

# Notional SW Maturity Lifecycle



# Maturity Evaluation Characteristics

- Represent areas/ dimensions affecting product maturity
- Must be considered both separately and as a group
- Weight of each characteristic may differ in any particular situation
- Must be evaluated against intended purpose



# Candidate Characteristics

1. Understanding of the potential for latent defects within the product
2. Understanding of the domain of product applicability
3. Predictability of product behavior (within well-defined parameters)
4. Product stability
5. Product supportability
6. Product pedigree

# Potential for latent defects

- Addresses the risk of undetected bugs
- Possible measures or information sources
  - History and trends of types/frequency of faults
  - Certifications and test packages
  - Test regimen
  - Test coverage



# Domain of product applicability

- Addresses risk of suitability of the product to the intended task
- Possible measures or information sources
  - Compatibility measures
  - Robustness (adaptability, scalability, portability, security, safety, integrity, etc.)
  - Availability and quality of design and maintenance documents
  - Certifications and test packages
  - Specific operational environment(s)
  - Limitations on product use

# Predictability of product behavior

- Addresses the risks associated with suitability of operational and functional quality
- Possible measures or information sources
  - Test regimen
  - Test coverage
  - History and trends of types/frequency of faults
  - MTBF
  - Availability
  - Recovery from faults
  - Compatibility measures
  - Accuracy
  - Completeness of features/functions definition

# Product stability

- Addresses the risks associated with historic volatility that could re-emerge
- Possible measures or information sources
  - Release history and frequency
  - History and trends of types/frequency of faults
  - Obsolescence potential
  - Software aging characteristics



# Product supportability

- Addresses the risks associated with continuing suitability of the product
- Possible measures or information sources
  - Availability of training
  - Availability of vendor/developer/consultant support
  - Recovery from faults
  - Mean time between failure
  - Availability and quality of design/maintenance documents
  - Dependency on events out of product control
  - Life expectancy
    - *First shipment date*
    - *End-of-life plans*
    - *Market share*
    - *Market trend*
    - *Rights granted on discontinuation of product*

# Product pedigree

- Addresses the risks associated with the developers/sources for the product
- Possible measures or information sources
  - Installed base
  - Market share
  - Market trend
  - Maturity of underlying technology
  - Customer references
  - Confidence in adherence to standards
  - History of upward compatibility



# Additional factors

- **Control over configuration/evolution**
  - Does the acquisition need to determine when or how the product will change and the type of features that may be added or dropped?
- **Predictability of evolution and obsolescence**
  - Does the acquisition have a clear understanding of the direction and speed of product evolution and the time remaining in the product's likely supported life?
- **Schedule**
  - Does the acquisition understand when the product will be available or updated (such as availability of NDI or required product functionality)?
- **Costs**
  - Does the acquisition understand the full costs associated with the product, such as licensing, refresh, maintenance

# Additional factors - 2

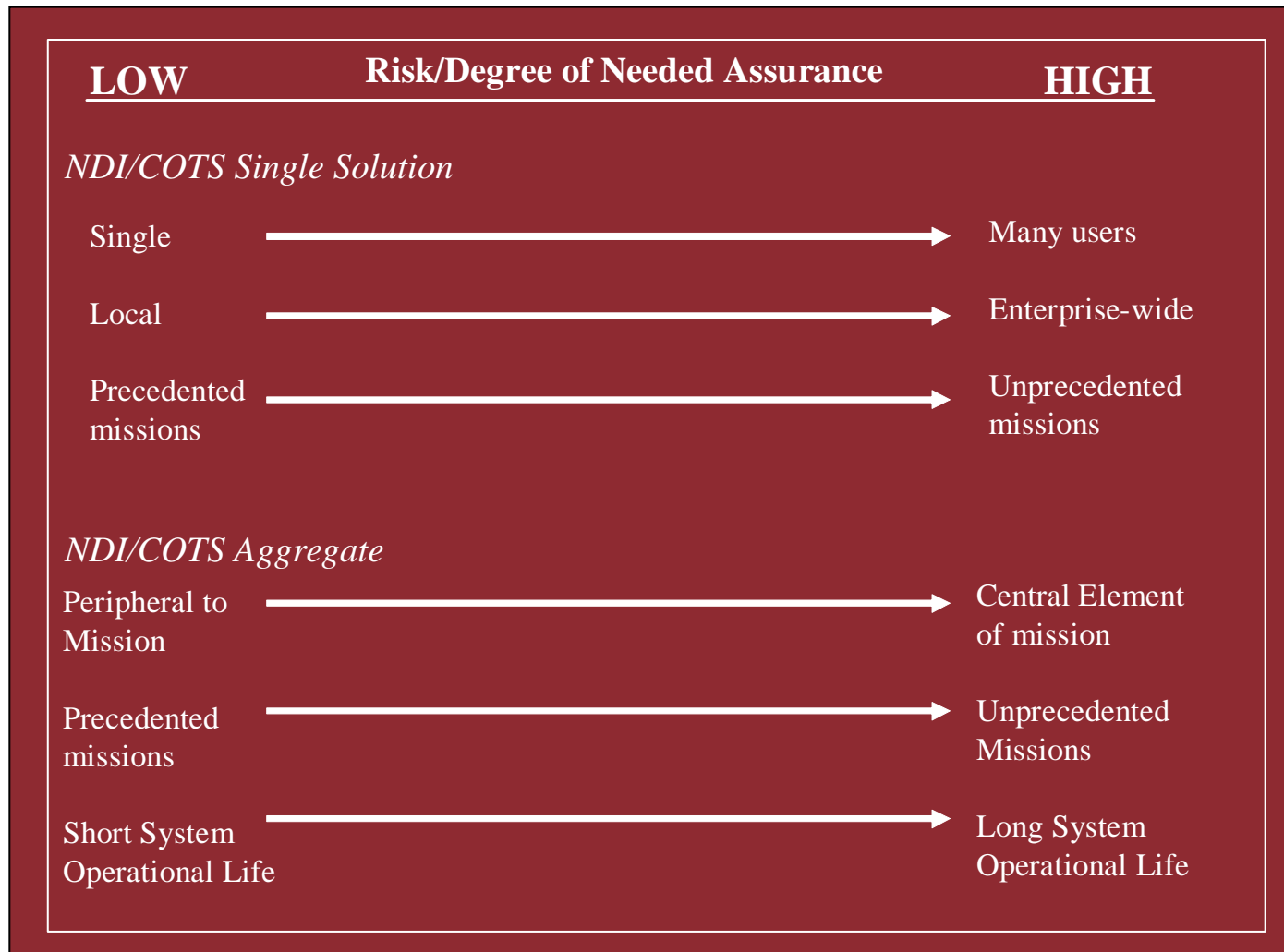
- **Architecture**
  - Will the product require significant changes to an existing software architecture?
- **Operational Context**
  - Will the product fit the current or envisioned modes of operation, operational environment (e.g. platform) and process context?
- **Fitness for use**
  - Do the product characteristics meet the needs of the envisioned use (such as security, availability, and scalability)?
- **Modification of product**
  - Will there need to be modifications to the product that will prevent normal developer/vendor refresh?

# Additional factors - 3

- **Release synchronization**
  - Will the vendor release schedule impact operations?
- **Pedigree of product developer**
  - Does the acquisition have confidence in the developer/vendor (including disclosure of subcontractors)?



# Context impacts risk



# Additional references

- *ISO/IEC 14598-4 Software engineering – Product Evaluation Part 4: Process for acquirers*
  - extensive guidance on evaluating software products.
- *ISO/IEC 9126-1 Information technology – Software quality characteristics and metrics – Part 1: Quality characteristics and subcharacteristics*
  - defines software quality characteristics
- **SEI Technical Reports**
  - CMU/SEI-2004-TR-013 *An Alternative to Technology Readiness Levels for Non-Developmental Software*
  - CMU/SEI-2003-TR-023 *Identifying Commercial Off-the-Shelf (COTS) Product Risks: The COTS Usage Risk Evaluation.*

# Maturity and Agile Development Approaches

- Agile can be effective determining many of the characteristic measures
  - Probability of defects
    - *Test-driven design*
    - *Short iterations yielding operational functionality*
  - Domain applicability
    - *More involved customer*
    - *Acceptance tests for each iteration*
  - Product stability
    - *Automated test environments*
    - *Continuous integration*
  - Product pedigree
    - *Nearly all agile techniques*



# Summary

- Maturity can only be measured on existing software
  - For source selection this means COTS, GOTS, NDI, prototype, experimental
- Initial set of software product maturity characteristics defined
- Maturity evaluation complex - dependent on context and related factors
- Agile approaches may make it easier to determine software product maturity

# Questions?

